Remarks:

<u>§102 Rejections</u>

Claim 12 stands rejected as anticipated by Sprague et al. Applicant has amended claim 12 to recite the additional step of: "setting a temperature set-point for laser diode operation, said set point corresponding to an output wavelength." Applicant has further limited the step of operating temperature control means, to "ameliorate changes in the output wavelength of the laser diode during plural consecutive activations thereof." Thus, the method allows the laser diode to be repeatedly activated within a particular wavelength range. This process provides control over the temperature of the diode such that it generates consistent, repeatable wavelength pulses. Sprague does not teach or suggest such a process. In fact, Sprague teaches changing the output wavelength of the laser from pulse to pulse via changes in temperature.

Applicant's approach controls the temperature, and consequently the wavelength of the laser used in an inspection/sensing system. Fluctuations or disruptions in the outputted wavelength can compromise the integrity of any vision-based sensing system. In addition to reduced accuracy, wavelength fluctuations can require longer processing time, and hence slow the overall manufacturing process to which the sensing system is integral. There is simply no teaching or suggestion from Sprague to continuously pulse a laser while controlling the temperature of the laser at each pulse, avoiding untoward changes in output wavelength. The rejection is therefore overcome and withdrawal of the same is respectfully requested.

Claim 14 stands rejected as anticipated by Rudd. Rudd does not teach a control circuit having a MOSFET, rather the Rudd MOSFET is positioned in the laser power supply circuit itself. Rudd therefore does not teach all the limitations of the present invention, however, Applicant has amended claim 14 to further characterize the structure of the claimed circuit

Applicant has limited claim 14 to a design wherein the MOSFET comprises a body diode (present and inherent in all MOSFETs) that is forward biased with respect to the preselected input polarity. This <u>structure</u>, i.e. the bias direction of the body diode with respect to the power supply current, is inherent in the originally disclosed, functionally described embodiment.

The MOSFET in Rudd will not provide reverse polarity protection to the laser. This is because the body diode of Rudd (not shown) allows current to flow to the laser when the circuit experiences a reversed polarity. During normal operation, the body diode of the MOSFET in Rudd is reverse biased with respect to an input current (opposite the bias direction of the laser diode itself). When polarity is reversed in the circuit, this body diode is forward biased, allowing current to flow in reverse polarity to the laser. At this polarity, the laser diode is reverse biased, and will become damaged if the applied voltage is above the maximum reverse voltage allowed. The power supply voltage in practice is usually between 3V and 6V (Figure 12 of Rudd illustrates a 6V power supply), enough to damage the laser diode if the power polarity is reversed. Applicant has attached a declaration, signed by the inventor of the invention of claim 14, attesting to the failure of the Rudd system to prevent a reverse voltage overpowering, and reference is made specifically thereto.

In contrast to the teachings of Rudd, Applicant has invented a control circuit design utilizing a MOSFET that will provide reverse polarity protection to the laser, distinct from Rudd. Referring to Figure 5, Applicant's design utilizes a control circuit having a body diode with its anode connected to the drain and cathode connected to the source (not illustrated but inherent in the MOSFET design). If the power supply polarity is reversed, the body diode will be <u>reverse</u> biased and the MOSFET will turn off since its gate voltage will be the same as the source voltage. Thus, during normal laser diode operation the body diode of the MOSFET will be forward biased. When a reversal of voltage polarity occurs, the body diode will be reverse biased, turning off the circuit and protecting the laser. Rudd does not teach a control circuit having a MOSFET as claimed, and the rejection to claim 14 is overcome.

<u>§103 Rejections</u>

Claim 1 stands rejected as unpatentable over Jing et al. in view of Takigawa et al. Applicant has amended claim 1 to additionally require a laser driver having a control circuit with a MOSFET that turns off the circuit when a reverse voltage is applied. Specifically, amended claim 1 requires:

> [A] control circuit connected to an input power supply for the laser diodes having a MOSFET which is turned on when a power supply voltage is higher than ground and turned off when a power supply polarity is reversed and power supply voltage drops below ground, thereby turning off the laser diodes.

The above features are set forth in Applicant's original disclosure at page 9, lines 7-15, and are similar to the limitations set forth in claim 14, as presently amended. Neither of the cited references discloses a laser driver with a control circuit having the claimed features, the rejection is overcome and withdrawal of the same is respectfully requested.

Claims 2-7 and 13 stand rejected as unpatentable over Freitag et al. in view of Jabr and Noda et al. Applicant has amended claim 2 to require the step of "calculating cumulative laser output power over time based on laser pulse peak output power and pulse duration." Applicant has further limited the step of disabling the laser to a situation wherein cumulative laser output power exceeds a predetermined limit. Applicant describes operation of the microprocessor's calculation of the cumulative laser powering at page 8 of the specification, lines 7-20. When the laser is overpowered, it is turned off to avoid a safety problem.

In contrast, Freitag does not teach continuously monitoring the parameters; the "window detector" does not allow the Freitag system to perform this function, as the detector is only capable of capturing discrete temporal pictures of the laser powering. Consequently, the laser power cannot be maximized without risking false alarms. For example, in Freitag, a laser pulse peak power will be compared to a preselected voltage threshold. If this voltage is exceeded, a fault condition is generated in the system. In Applicant's design, continuous monitoring allows the pulse peak power to be integrated with the pulse duration. This allows relatively higher power pulses to be used, so long as the total powering does not exceed the preset safety limit. Neither Jabr nor Noda teach calculating the cumulative laser output power. Because the cited references do not teach all the limitations of the present invention, the rejections to claim 2 and the claims dependent thereto are overcome and withdrawal of the same is respectfully requested.

Regarding claim 13, the Examiner argues that "given the broadest interpretation, the fault point of these references [pulse magnitude and duration] will

necessarily be a predetermined product value of pulse magnitude and duration." This rejection is traversed for the reason that there is no teaching in the cited references to measure the product values of the pulse magnitude and duration. The Examiner would appear to interpret the cited art as teaching turning off the laser when the product values of pulse duration and pulse frequency exceed a predetermined limit. However, Freitag teaches detecting fault conditions when voltage thresholds are passed (Column 3). The Examiner has not explained how the cited references teach determining product values of pulse magnitude and duration, beyond the bare assertion that they do so, and the rejection is therefore traversed. Applicant has further amended claim 13 to require remote monitoring of the pulse magnitude as well as frequency and duration. The cited references do not alone or in combination teach or suggest the monitoring of these values.

Claims 8-11 stand rejected as unpatentable over Chambers et al. in view of Underwood, Jr. et al. Applicant has amended claim 8 to require that the temperature control means are operable to "ameliorate temperature change" of the laser diode, within a range "of about one degree from a temperature set point corresponding to a desired output wavelength of said laser diode." There is no teaching or suggestion from Chambers or Underwood to control the output wavelength of the laser diode by controlling the temperature thereof, particularly within the claimed range of about one degree. Moreover, Chambers is actually directed to a design wherein the spectral stability of the lasers is *intentionally* disrupted (Columns 2 and 3, in particular). Thus, Chambers teaches away from a design that operates to avoid fluctuations in the output wavelength of the laser. The rejections to claims 8-11 are therefore overcome, and withdrawal of the same is respectfully requested.

WHEREFORE, all the issues raised in the most recent office action are believed resolved, placing all the pending claims in condition for allowance, which is respectfully solicited.

If the Applicant may provide any further information or be of any further assistance in the prosecution of this examination, the Examiner is invited to contact the undersigned at (248) 364-2100.

Sincerely,

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